

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Amendment of the Commission's Rules with)	GN Docket No. 13-185
Regard to Commercial Operations in the 1695-)	
1710 MHz, 1755-1780 MHz, and 2155-2180)	
MHz Bands)	
)	
Service Rules for Advanced Wireless Services)	WT Docket No. 07-195
In the 2155-2175 MHz Band)	(Proceeding Terminated)
)	
Service Rules for Advanced Wireless Services)	WT Docket No. 04-356
In the 1915-1920 MHz, 1995-2000 MHz,)	(Proceeding Terminated)
2020-2025 MHz, and the 2175-2180 MHz)	
Bands)	
)	
Applications for License and Authority to)	WT Docket No. 07-16
Operate in the 2155-2175 MHz Band)	(Proceeding Terminated)
)	
Petitions for Forbearance Under)	WT Docket No. 07-30
47 U.S.C. § 160)	(Proceeding Terminated)

**COMMENTS OF
RAYTHEON COMPANY**

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SUMMARY

Raytheon Company (“Raytheon”) focuses primarily on the proposed allocation of the 1695-1710 MHz band to commercial Advanced Wireless Services (“AWS”) and the rules that would govern AWS users sharing that spectrum with existing Federal Meteorological Satellite System and Meteorological Aids System (collectively “MetSat”) users. Raytheon brings broad experience with MetSat solutions to this task, and it was an active participant in the Working Group 1 (“WG-1”) process leading to the reports on the 1695-1710 MHz band submitted to the Commerce Spectrum Management Advisory Committee (“CSMAC”) in 2012 and earlier this year, laying groundwork on certain points for this proceeding.

Although increasing the amount of spectrum available to the commercial mobile wireless broadband industry, as what the Notice of Proposed Rulemaking (“NPRM”) proposes, is a key element of addressing its capacity requirements, spectrum also plays an increasingly important ongoing role in supporting many other key facets of our nation’s economy, activities, and interests. The actions that the Commission takes regarding 1695-1710 MHz must be especially mindful of MetSat requirements and the beneficiaries of that data and offer adequate protection.

Domestic MetSat systems such as the Polar Orbiting Environmental Satellite System and international partner polar-orbiting satellites such as Europe’s MetOp transmit data to Federal users in the 1695-1710 MHz band. Geosynchronous MetSat satellites and radiosondes (i.e., Meteorological Aids) use 1675-1695 MHz for similar purposes. Reliable collection of the data from these systems is critical for accurate weather forecasting, timely and coordinated public safety responses to weather and environmental emergencies, generation of scientific data products and specialized warnings, and climate and environmental monitoring among many

other uses. The results from these efforts are relied upon by multiple industries such as civil and military aviation, energy, maritime operations, space, and broadcast and mobile media.

The WG-1 work, as constructive as it has been, did not reach many of the key issues raised in the *NPRM*. These include the coordination processes and procedures, testing and validation, interference resolution, and enforcement, among others. For spectrum sharing framework to work, these issues must be addressed in a way that protects Federal MetSat operations in the 1695-1710 MHz band and in the frequencies below 1695 MHz.

Protection Zones: All twenty-seven (27) Federal MetSat earth station sites identified in the Working Group process should be protected from harmful interference from AWS operations. In addition, the rules should be flexible enough to accommodate prospective changes and modifications to the protected sites which may occur as the result of a variety of factors, including the evolution of Federal uses of MetSat data, the obsolescence of existing Federal ground facilities, and external circumstances that may require a facility to change location, to name a few examples. If the rules cannot accommodate such potential changes, then critical MetSat operations and systems may be adversely affected, negatively impacting a broad range of governmental and non-governmental activities.

In addition, the contours of the proposed Protection Zones have not yet been verified through actual testing. The proposed Zone contours were calculated specifically assuming the use of the Long Term Evolution (“LTE”) standard by AWS systems in the 1695-1710 MHz band. Raytheon submits that the LTE standard should be mandated for AWS licenses in this band. If the Commission does not mandate LTE, then the rules should accommodate the potential need to resize the protection Zones in particular cases based on the systems that will be deployed by the auction winners in the 1695-1710 MHz band.

Coordination: Raytheon submits that the coordination procedures governing shared use of the 1695-1710 MHz band should not establish defaults applicable to Federal users' responses to Protection Zone coordination requests. Rather, in any given case, AWS licensees should be required to obtain the affirmative consent of the incumbent Federal operator before commencing operation. Federal operators receiving a coordination request, which will contain detailed analyses and may propose use of novel techniques by AWS licensees to facilitate sharing, will face a number of challenges making defaults inappropriate, including the potential lack of detailed data regarding equipment at the protected sites, and the need for further due diligence and consultation with a variety of sources. In addition, if an LTE standard is not utilized by the AWS licensee, review of any analysis supporting a coordination request will be further handicapped as the potential interaction of that AWS system and the Federal site will be even less understood. Fortunately, there already has been considerable work to reduce the circumstances in which coordination will be required in order to maximize AWS utilization of the 1695-1710 MHz band on a shared basis leading to proposed Protection Zones much smaller than the Exclusion Zones central to the original conception for shared use of the band.

The rules should also make clear that AWS licensees that have already coordinated successfully with a Federal user within a particular Protection Zone must engage in further coordination whenever there are changes to the operation (or ownership) that are not within the scope of the AWS system as defined in the original coordination.

Interference Prediction Model: The *NPRM* correctly recognizes the need for a nationally-approved interference prediction model, and Raytheon will review with interest proposals regarding the interference prediction model. Additionally, where there may be more than one AWS operator within or adjacent to a single Protection Zone, the Commission's rules should

reflect a model where adhering to established interference protection criteria (“IPC”) limits at the protected Federal site within that Zone is the joint responsibility of those multiple AWS operators. The rules should set default, per-system IPC limits in multiple operator scenarios which AWS operators should be free to modify at a given location pursuant to contract.

Testing and Monitoring: WG-1 correctly recognized that testing is needed to validate the analysis model and the proposed Protection Zone distances. Such testing will require the participation of protected Federal systems and terrestrial mobile equipment representative of an AWS licensee’s intended operations, with representative loading. Unless a known industry standard is mandated, testing prior to the adoption of Commission rules is impractical and potentially meaningless. In the event testing is not practicable before the rules are finalized and can occur only following auctions, Commission’s rules should make clear that the Protection Zone contours in individual cases may have to be resized as a result of post-auction testing. Testing should be a prerequisite to any coordination request.

AWS licensees should be required to monitor their adherence to applicable IPC limits and adjust their system operations in real-time to avoid exceeding those limits. In addition, AWS licenses should have an independent obligation to cooperate with and support Federal user efforts to monitor the interference power spectral density (“IPSD”) into the protected Federal receivers within each Protection Zone. Such AWS licensee support should include, in defined circumstances, exchanging AWS network and monitoring system data with the Federal user. AWS licenses should also have an obligation to assist federal users in identifying the source of interfering signals where harmful interference occurs.

Interference Resolution and Enforcement: As proposed, incumbent Federal systems within the Protection Zones should be entitled to interference-free operation from both

coordinated operations inside the Protection Zone and uncoordinated operations outside. AWS licensees should have the obligation, in both scenarios, when there is interference to the protected Federal systems to “modify the stations' location and/or technical parameters as necessary to eliminate the interference,” as proposed, and to take on the primary responsibility to identify sources of interference in the band that are not AWS-related. In any interference event, the default should be that AWS operations must be adjusted or even stopped to eliminate the interference, unless the AWS licensee(s) can demonstrate that such adjustments or cessation of operation would not eliminate the received interference, *i.e.*, a third party source is the sole cause of interference. This approach would establish the proper incentives and adequately protect the Federal sites from harmful interference, whatever their source, which should remain the primary objective.

The Commission should actively enforce the rules that it adopts to govern sharing, including obligations of AWS licensees to monitor adherence to, and to not exceed, established IPC limits. Enforcement fines and forfeitures should be significant and promptly determined to deter violations. The Commission should also make clear that in particularly egregious situations of interference or failure to comply with technical or operational standards, loss of license may be a remedy.

Performance Requirements: Raytheon submits that the populations within Protection Zone should not be used to measure whether build out requirement are met. It cannot be ascertained in advance whether an AWS license will ever be able to operate within a Protection Zone. The sole consideration in a coordination scenario should be whether the proposed operations would pose a threat of harmful interference to the protected Federal

facilities. Inclusion of Protection Zone populations may prove fundamentally unfair to licensees in cases where future coordination does not prove workable.

2095-2110 MHz: NASA has prepared a comprehensive analysis on co-frequency interference to the Tracking and Data Relay Satellite System spaceborne receivers which renders any shared use with the commercial mobile wireless broadband systems in the 2025-2110 MHz infeasible. Raytheon urges the Commission, as a result, to avoid pairing 1695-1710 MHz with any segment of 2025-2110 MHz.

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**COMMENTS OF
RAYTHEON COMPANY**

Raytheon Company, by its attorneys, submits its comments in response to the Notice of Proposed Rulemaking in the above-referenced proceeding.¹ The Commission seeks comment on approaches to spectrum sharing between commercial and Federal operators in several bands between 1.7 and 2.2 GHz. Raytheon addresses its comments on meteorological

¹ *Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, Notice of Proposed Rulemaking and Order on Reconsideration, FCC 13-102, GN Docket No. 13-185(rel. July 23, 2013) ("NPRM").

and environmental spectrum and associated space operations of Federal systems, dealing primarily with in-band and adjacent-band considerations in the 1695-1710 MHz band.

I. STATEMENT OF INTEREST AND INTRODUCTION

Raytheon Company is a technology company operating in the defense, aerospace and related government markets in the United States and internationally. Raytheon has broad experience in providing environmental solutions covering sensor development, space systems payloads, command, control and communications systems, space mission data processing, space systems operations and maintenance, and information dissemination, including broadcasts and warnings. Raytheon has broad experience in meteorological and environmental systems associated with satellite meteorology and the use and dissemination of data products that contribute to the generation of weather forecasts, storm watches and warnings, and specialized meteorological products. Domestic Meteorological Satellite (“MetSat”) satellites such as Polar Orbiting Environmental Satellite (“POES”) and international polar-orbiting satellites such as Europe’s Meteorological Operation (“MetOp”) transmit data to Federal users in the 1695-1710 MHz band. Geostationary MetSat space stations, such as Geostationary Orbiting Environmental Satellite (“GOES”), operate primarily in the 1675-1695 MHz band, although some downlink transmissions from such satellites occur above 1695 MHz. MetSat space stations downlinking in the 1675-1695 MHz and 1695-1710 MHz bands are a significant source of the total data used by non-governmental as well as governmental organizations that are necessary to support weather forecasting, timely and coordinated public safety responses to weather and environmental emergencies, generation of scientific data products and specialized warnings, and climate and environmental monitoring among many other uses. The Federal meteorological and environmental products generated from the data collected and transmitted by these satellites

supports multiple industries such as civil and military aviation, spacecraft operation on orbit, energy production, generation and distribution, commercial and other maritime operations, and broadcast and mobile media.

Raytheon recognizes that increasing the amount of spectrum available to the commercial mobile wireless broadband industry is a key element of addressing their capacity requirements. But Raytheon is equally mindful of the increasingly important role spectrum plays in supporting many other key facets of our nation's economy, activities, and interests, as well. Better and more weather and environmental information is an increasingly vital and ongoing part of supporting many areas of the nation's economy and governmental, civic, commercial, and private activities. Interruption to weather and environmental data would impact a broad range of users in many fields.

Raytheon was an active participant in the Working Group 1 ("WG-1") process. The WG-1 efforts led to the reports submitted to the Commerce Spectrum Management Advisory Committee ("CSMAC") in 2012 and earlier this year regarding recommendations for a regulatory framework whereby Advanced Wireless Services ("AWS") and Federal MetSat meteorological systems would cohabitate the 1695-1710 MHz band.² Raytheon's engineering personnel have a high degree of likelihood to be involved in implementing some of the protections necessary for Federal systems or to place future Federal stations within the proposed Protection Zones under government contract.

Raytheon brings its insights from the Working Group processes to these comments. The *WG-1 Report*, as helpful as it was, did not reach many of the key issues in the

² Indeed, Raytheon technical personnel supported multiple Working Groups organized by CSMAC to examine issues regarding, not only the 1695-1710 MHz band, but 1755-1780 MHz, as well.

NPRM, such as coordination processes and procedures, testing and validation, interference resolution, and enforcement. In order for the spectrum sharing framework to work, it is important that the Commission (and NTIA) properly balance numerous factors in addressing these and other issues.

II. THE PROPOSED BASIC REGULATORY FRAMEWORK MUST BE STRUCTURED TO ADEQUATELY PROTECT INCUMBENT METEOROLOGICAL OPERATIONS

A. Overview

During discussions within WG-1, no detailed presentations were held on the use of the broadcast re-transmissions from National Oceanographic and Atmospheric Administration (“NOAA”) space stations or international satellites nor were there any presentations about the role of some of the US&P Federal stations in international networks. Raytheon wishes to fill that gap here, necessarily to a limited degree, and provide information on this subject that should be of benefit to the Commission and NTIA as they make the decisions to establish the regulatory framework for AWS access to the 1695-1710 MHz band which accommodates, through sharing, continued interference free operation of MetSat systems in that band and the adjacent 1675-1695 MHz band.

Many users depend on the data products derived from MetSat systems that rely on the availability of frequencies in the 1695-1710 MHz band and the adjacent 1675-1695 MHz band.. However, Raytheon submits that many, if not a majority, of users are unlikely to appreciate the potential impact on those products if receiving systems are not adequately protected from interference as AWS operations are introduced into 1695-1710 MHz band. Few end users

associate the products derived from the MetSat systems with the downlink spectrum necessary to obtain it.

Although the *NPRM* interprets the Spectrum Act to give clearing spectrum (*e.g.*, moving all Federal users out) priority over spectrum sharing, the Commission correctly recognizes that relocation of incumbent users in the 1695-1710 MHz band is not technically feasible.³ The *NPRM* recognizes that continued use of the band at certain identified Federal sites must be accommodated.⁴ Due to the investment in existing and in-development satellite systems for meteorological and environmental services, Raytheon urges the Commission to give proper consideration to both U.S. and international satellites that utilize this band for direct data downlink or retransmission when developing rules permitting AWS usage of 1695-1710 MHz.⁵

³ See, *e.g.*, *NPRM*, ¶¶ 1-2, 27, discussing the Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156 (2012) (“Spectrum Act”).

⁴ Within the United States and Possessions (“US&P”), multiple Federal government agencies, state, local, tribal and territorial governments, private sector meteorology companies, industries, universities and the general public currently receive timely live satellite data at receive-only earth stations. Since neither the Commission nor NTIA require registration of receive-only earth stations operating at 1675-1695 MHz, a comprehensive list of such stations does not exist. Yet many of these users benefit from reception of international satellite information, and many of the Federal sites proposed for protection support international activities that, in turn, support domestic and international users. For example, the aviation industry relies upon WMO Meteorological Watch offices for detection of volcano eruptions in international airways, warnings for tropical cyclones (*e.g.* hurricanes), uplink and downlink of meteorological information and turbulence reporting and warnings. Key elements of this data are received or rebroadcast via L-band. As another example, many islands receive their sole source of tsunami warning or impending severe weather conditions from satellite broadcasts. Many NOAA specialized centers utilize the directly-received satellite data in the 1695-1710 MHz band or the adjacent 1675-1695 MHz band. This is especially important for states and territories comprised of islands, as well as for island nations. There are numerous other examples which could be provided.

⁵ Eight countries or trans-national entities have either polar-orbiting or geosynchronous meteorological satellites: China, the European Union, France, India, Japan, Republic of Korea, the Russian Federation and the United States. Further, 185 member states belong

Those satellite systems will have space assets downlinking in this spectrum through at least the year 2030. In the course of the work of the ITU's Joint Task Group 4-5-6-7, the World Meteorological Organization ("WMO"), the European Organisation for the Exploitation of Meteorological Satellites ("EUMETSAT") and the Administration of China have all submitted contributions underscoring the significant value of 1695 -1710 MHz for meteorological and environmental services and the unique role the band plays.⁶ Raytheon submits that the sunk costs into the existing meteorological and environmental satellites of the U.S. and other Administrations and associated earth stations demands that 1695-1710 MHz be shared instead of cleared in the United States, as proposed in the *NPRM*.

The key to the sharing framework is eliminating, to the extent practicable, the potential for harmful interference to the protected MetSat earth stations. The ramifications of Federal spectrum sharing, if the protection against interference is inadequate, certainly could be felt well beyond the potential impact on operation of Federal sites identified in the *NPRM* as deserving of protection. All users in this country and worldwide receive data collected by earth stations

to the World Meteorological Organization ("WMO") and nearly all use products derived from the data obtained by these satellites. Satellite data are shared by the space-faring meteorological organizations of the above countries with the world's national meteorological and hydrological services. See Annex I to Resolution 40 (Cg-XII) "Data and products to be exchanged without charge and with no conditions on use," which may be found at: http://www.wmo.int/pages/about/AnnexItoRes40_en.html.

⁶ Media reports indicated that foreign satellites could fill any potential future on-orbit gaps in coverage by U.S. satellites. However the specific satellites (FY-3 series) use 1695-1710 MHz to high resolution downlink data to Earth. <http://www.spacenews.com/article/civil-space/36931report-chinese-weather-sats-could-fill-us-gap> The EUMETSAT comments on 1695-1710 MHz band sharing may be found at 190 <http://www.itu.int/md/R12-JTG4567-C-0190/en> The People's Republic of China filed document 199 with the ITU JTG 4-5-6-7 Task Group to oppose the sharing of 1695-1710 MHz. <http://www.itu.int/md/R12-JTG4567-C-0199/en> WMO opposes sharing in its submission. <http://www.itu.int/md/R12-JTG4567-C-0120/en>.

located within the boundaries of the US&P. In addition, reception of data within the boundaries of the US&P from international satellite systems using the 1695-1710 MHz band as a result of international agreements is often relied upon by Federal users.⁷ For example, current generation polar satellite coverage – POES in the United States – uses 1695-1710 MHz for downlink transmissions. NOAA partners with EUMETSAT to operate the POES system and a European polar-orbiting satellite called MetOp in complementary orbits. EUMETSAT’s MetOp satellites provide the “mid-morning” coverage for NOAA using this same spectrum under the International Joint Polar Program, while NOAA provides the “afternoon” orbit. Both agencies share all the satellite data, which form the backbone of all medium range weather forecasts in the United States and Europe and make up the majority of the data used by U.S. weather model Global Forecast System (“GFS”) and the major three-to-ten day European weather model (European Centre for Medium-Range Weather Forecasts (“ECMWF”).⁸

Key satellite methods in use for MetSat space stations to relay data into national meteorological and hydrological services, or relay via commercial satellite from data originally received at L-band, are High Resolution Picture Transmission (“HRPT”) and Low Rate

⁷ At the same time, underscoring the international nature of collecting and using meteorological data, other Administrations and international users rely upon data downlinked outside the US&P by United States MetSat space stations as well as the meteorological satellites of other Administrations.

⁸ Weather forecasting and other meteorological activities are truly international efforts today. MetOp satellite data are acquired locally by a network of High Resolution Picture Transmission (HRPT) reception stations within the North Atlantic, Europe and Indian Ocean regions. NOAA receives HRPT data at key sites, including Monterey, Miami, Honolulu; these data are then, typically, either processed by local processing nodes for incorporation into NOAA’s distribution or relayed to EUMETSAT for onward distribution to their users. (World Meteorological Organization reports the following HRPT sites in US&P: Monterey, Wallops Island, Fairbanks, Ewa Beach, HI, Miami and Madison WI.) See http://www.wmo.int/pages/prog/sat/documents/RARS_HRPT-Stations-status-and-plans.pdf.

Information Transmission (“LRIT”). HRPT downlinks are used by polar-orbiting and geostationary MetSat space stations, LRIT is used predominantly by geostationary stations, although at least one polar-orbiting system as described below will use LRIT.

HRPT is a worldwide direct readout of high resolution (1 km) spacecraft parameters and instrument data to ground stations within the footprint of NOAA polar orbiters. Polar orbiter HRPT downlinks typically occur in the 1695-1710 MHz band. The HRPT data on the POES satellites can only be transmitted directly from the satellites to users on the ground. Polar satellite direct broadcast provides a 1 km resolution, real-time image of the location immediately below the satellites. There is no ability to store the high resolution images on the spacecraft and then transmit them over a fixed ground station for redistribution⁹ If highest-resolution imagery from POES is lost because of in-band radio frequency interference, it cannot be stored and transmitted later. These images are used for forecasting, wildfire detection and warning, oil spill detection and tracking and for operational products used by the marine transportation and fishing industries. HRPT also provides timely day and night sea surface temperature, ice, snow and cloud cover information to diverse users. Europe’s MetOp satellite contains Advanced High Resolution Picture Transmission (“AHRPT”) direct readout service.¹⁰ HRPT and AHRPT transmissions contain data from nearly all instruments aboard NOAA and MetOp polar satellites, respectively.

⁹ NOAA Office of Satellite and Product Operations, “GOES and GOES-R Spectrum Issues: L-band Status”, November 16, 2010 located at <http://www.ofcm.gov/copc/meetings/2010-02/12-GOES-and-GOES-R-L-Band-Status.ppt>.

¹⁰ See <http://www.wmo-sat.info/oscar/satellites/view/307>.

Another payload downlinks in the 1695-1710 MHz band from POES, MetOp, and additional polar-orbiting international satellites. The ARGOS network of stations for tracking and data relay for the current ADCS-3 instruments on MetOp and POES downlink once per orbit. For POES, those ground stations are Wallops Island and Fairbanks.¹¹ For the next generation JPSS-Free Flyer satellite, the ADCS downlinks are proposed at 1697.5 MHz for compatibility with the international network of seventeen stations which receive the Advanced Data Collection System 4 information. In the US&P, these sites would be Miami, Monterey and Guam. The JPSS Free Flyer satellite will downlink their data set every 3 minutes to an international ground network (that currently supports the joint India France altimetry satellite SARAL¹²) of stations which includes the above US&P locations. These satellites are not designed to store data and then use once-per-orbit downlinks such as are often used on older systems. Any interference from AWS stations would delay this critical tracking data.

LRIT broadcasts have less data content than HRPT transmissions, as the names suggest, and provide users with additional imagery data, products and broadcast services, predominantly from geostationary satellites. The data from geostationary MetSat systems are used daily in the protection of life and property and the generation of weather predictions and reports that are broadcast over television, radio and the internet throughout the country and by U.S. ships in coastal waters. This spectrum is the source for the weather data that are displayed on smartphones and tablets.

The current generation GOES systems, series N through P, contain payloads for meteorology, search and rescue, space environment monitoring, data collection platform, data

¹¹ Worldwide there are about 60 HRPT stations that carry A-DCS information.

¹² The Satellite with **ARGOS** and **ALTIKA** (“SARAL”) launched on February 25, 2013.

gathering and high rate and low rate data. These payloads support the following 1675-1695 MHz downlinks: Sensor Data Link, Multi-Use Data Link, Processed Data Relay/GOES Variable, Low Rate Information Transmission, Emergency Managers Weather Information Network (“EMWIN”) and the Data Collection Platform Report (“DCPR”).¹³ These platforms support visible and infrared imagery as well as other hydrometeorological products. With the next generation geostationary satellite, GOES-Series R (“GOES-R”), data being rebroadcast in the adjacent spectrum (1681.55-1692.05 MHz) GOES Rebroadcast (“GRB”) downlink, will provide rebroadcast of all imagery and products from the GOES-R satellite series, with a dual-polarized, efficient downlink.¹⁴ This will be the only source for GOES-R imagery for private sector users in the United States, including all GOES-R images seen on broadcast television and the internet. Private entities may not connect directly to the NOAA network under NOAA policy.¹⁵ Space weather warnings for the power industry, aviation, and orbiting satellites will also be derived from the GRB downlink.¹⁶ This downlink is directly adjacent to the spectrum currently planned

¹³ For more data see the launch press kit at http://www.nasa.gov/pdf/361130main_Goes-Orbital_Presskit_rev8.pdf

¹⁴ Frequency usage for GOES N-P and R series are contained in the NTIA Fast Track report in Table 3-1. Technical characteristics for Federal Systems Operating in 1695-1710 MHz are found in Appendix A of the NTIA Fast Track Report. *See* NTIA, “An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands,” at p. 3-2, Table 3-1, October 2010 (“FTR”), found at <http://www.ntia.doc.gov/report/2010/assessment-near-term-viability-accommodating-wireless-broadband-systems-1675-1710-mhz-17>.

¹⁵ *See* <http://www.ospo.noaa.gov/Organization/About/access.html>.

¹⁶ More generally, GOES-R is an advanced design containing spectral imagers, lightning mapper, space environment sensors for Extreme UV and X-ray irradiance (can impact communications and navigation operation) and a solar UV imager (enabling forecasting of space weather that can impact power systems, aviation and communications satellites), a magnetometer. These payloads support the following 1675-1695 MHz downlinks: GRB, EMWIN/High Rate Information Transmission (“HRIT”) and DCPR.

for auction. GRB is the next generation of the GOES Variable (“GVAR”) downlinks (1683.6-1687.8 MHz) which currently are used on GOES N/O/P satellites.¹⁷

As noted in Raytheon’s June 2010 comments in response to the Notice of Inquiry regarding the 1695-1710 MHz band,¹⁸ EMWIN is an important warning system enabled by the GOES (and GOES-R) families of satellites for the emergency management community to use during natural and manmade disasters. In the current GOES, EMWIN utilizes a center frequency of 1692.7 MHz. In the next generation GOES-R series satellite, EMWIN utilizes a center frequency of 1694.1 MHz with a bandwidth of 1.205 MHz. The extremely close proximity of the GOES-R era EMWIN downlinks to the 1695 MHz band edge will preclude many filtering options to allow protection of this critical link for thousands of users. It is critical that the processes in this proceeding be implemented to avoid interference to the specified protection zones where EMWIN is monitored for proper operation.

The Data Collection Program (“DCP”) utilizes spectrum on both GOES and GOES-R satellites. DCP provides an environmental data point-to-point relay throughout the Western

¹⁷ The National Weather Service and other Federal agencies also operate Meteorological Aids (“MetAids”) in the 1675-1683 MHz portion of the band. Radiosonde observations are conducted by NOAA/NWS at 87 receive sites within the US&P and are an integral part of the World Meteorological Organization’s Global Observing System. Radiosonde transmitters are launched at least twice per day, each transmitting for approximately 2.5 hours per flight. *See FTR* at 3-17. During and in advance of landfall of Hurricane/Tropical Storm Sandy, an additional 615 radiosondes were launched at two different daily times in the 8 days in advance of landfall. *See* “Introduction to Sandy and the Major Impacts,” Dr. Louis W. Uccellini, NOAA, located at <http://blog.ametsoc.org/weather-systems/hurricane-sandy-nhc-final-report-and-ams-town-hall-presentations-online/>. The additional radiosonde data were made available real time to numerical weather prediction models and forecasters. Radiosonde data are critical to the short term weather forecast and additional launches contributed (along with the major use of satellite data) to the National Hurricane Center’s forecast track of the landfall location of the storm.

¹⁸ Comments of Raytheon Company, ET Docket No. 10-123, June 28, 2010.

Hemisphere. This system allows information from land, sea or mobile-based data collection platforms to transmit through GOES or GOES-R and back to the Wallops Island station and to Direct Readout Ground Stations (“DRGS”) throughout the hemisphere. Some DCP examples include: river gauges which measure water levels (useful in flood control), seismic event monitors and ocean buoys. DCP downlinks on the current GOES satellites are in the 1694.3-1694.7 MHz spectrum. DCP downlinks on the future generation GOES-R satellites will be 1679.7 – 1680.1 MHz

In light of the varied and important MetSat system uses made of the 1695-1710 MHz band and adjacent band, as described above, Raytheon submits that the framework the Commission adopts for AWS sharing with MetSat operations in the 1695-1710 MHz band is critical to the continued generation and delivery of much of the world’s medium range weather forecast, data collection relay and on-orbit tracking. Impact to Federal services in-band or adjacent to the planned AWS allocation in the 1695-1710 MHz band could adversely affect time sensitive warnings for space weather, volcanic ash events, wildfire detection and flood monitoring and impact data that is critical for the three-to-ten day weather forecasts. International satellites contribute to the data set of this information, making relocation completely impractical and spectrum changes technically prohibitive for the U.S. and foreign satellites in orbit and under development. It is not possible, nor desirable to consider relocation of meteorological and environmental satellite spectrum. Sharing is the only option in 1695-1710 MHz.

B. Particular Issues Raised in the *NPRM*

For sharing with co-band and adjacent band MetSat systems to occur successfully as AWS licensees are introduced into the 1695-1710 MHz band, there are a number of issues that

must be covered in the Commission's rules that were not addressed in the *WG-1 Report* to ensure the MetSat operations are adequately protected against harmful interference. The *WG-1 Report* articulated only the most basic of sharing frameworks, which, without significant exaggeration, can be reduced to the following statement in the Report:

The framework is conditioned on Protection Zones that will be based on the NTIA interference analysis and protection criteria, including aggregate Interference Power Spectral Density (IPSD) limits, to be determined for each receiver location. The framework provides for deployment of commercial operations outside of the Protection Zones without any coordination. It also permits commercial operations within the Protection zone following a successful coordination process concluding that such commercial operations can meet specified conditions and will not cause harmful interference to ensure no loss of federal capability within the protection zones. If coordination is unsuccessful, commercial operations will not be permitted within the Protection Zone.¹⁹

This above is more than just a summary statement. *It is for all practical purposes the entire sharing framework* articulated in the *WG-1 Report*. This is not to belittle in any way the extraordinary efforts of Working Group-1 in tackling threshold issues to advance the process beyond NTIA's Fast Track Report. But there are key issues that WG-1 simply did not have the time and resources to address which the Commission must tackle before sharing is implemented and/or rules are finalized, to the extent they fall within its jurisdiction.

Unfortunately, WG-1 did not have the opportunity to flush out all of the details of the regulatory framework. There are significant holes that yet have to be filled in either by the

¹⁹ Commerce Spectrum Management Advisory Committee Final Report, Working Group 1 – 1695-1710 MHz Meteorological-Satellite, Rev. 1, at 2 (July 23, 2013) (“WG-1 Report”). Appendix 1 to the Report also provides that “[i]f federal users at a protected facility receive harmful interference, commercial wireless licensees will, upon notification, immediately cease operation on the channels and in the area of concern until the interference is resolved through the [yet to be] established NTIA and FCC facilitated processes.”

Commission in its rules, to the extent the resulting obligations will apply to the AWS licensees operating in the 1695-1710 MHz band, or by NTIA and the federal agencies that use this spectrum or benefit from its use by other federal agencies (or both). The final rules should apply equally to protect geostationary and radiosonde operations in the adjacent 1675-1695 MHz band.

To implement the foregoing framework, the Report recognized “that the criteria and procedures for coordination and operation within the Protection Zones, as well as enforcement mechanisms, must still be clearly defined and subsequently codified in the FCC rules and the NTIA manual, as appropriate.”²⁰ Raytheon submits that following issues must be resolved before final rules are adopted, most of which were properly characterized by the Report as “necessary elements that remain to be addressed:”

- Procedures which will govern coordination within the Protection Zones²¹
- A nationally-approved interference prediction model (including associated input parameters and the distribution of aggregate interference protection criteria (“IPC”) limits among commercial licensees)
- “[A] testing program to demonstrate the viability and effectiveness of proposed protection and mitigation methods before commercial licensees may begin operations within a Protection Zone.”²²
- Procedures for “implementing on-going real-time monitoring to ensure [applicable interference protection] limits are not being exceeded and that commercial operations can be *adjusted immediately* if they are.”²³

²⁰ *WG-1 Report* at 2.

²¹ WG-1 recommended that there be an automated coordination process, to the extent possible, “to assess if the proposed commercial network[s] will meet the IPSP limits” and “to facilitate coordination allowing commercial licensee operations within the Protection [Zones].” *WG-1 Report* at 2. Raytheon disagrees that an automated coordination process is feasible or advisable, for the reasons discussed further below in Section II.B.2.

²² *Id.*

²³ *Id.* (emphasis added)

- A framework to address resolution of disputes concerning harmful interference to the MetSat systems at the protected Federal sites resulting from the operation of co-channel or adjacent channel AWS systems.
- An enforcement framework that applies against AWS licensees in the event of interference to protected federal users in the 1695-1710 MHz band.

These are all critical issues to be addressed by the Commission if sharing is to be successful. As discussed below, Raytheon offers principles which it submits should guide the Commission as it considers appropriate rules to flush out these critical points and several other aspects of the sharing framework.

1. Protection Zones

The *NPRM*, following the recommendations of the *WG-1 Report*, proposes to create Protection Zones for meteorological downlinks in the 1695-1710 MHz band, as well as below 1695 MHz, at twenty-seven (27) listed Federal sites identified in the Working Group process and at no non-Federal sites.²⁴ Raytheon submits that all 27 of these sites should be protected from harmful interference from AWS operations in the 1695-1710 MHz band. As explained in Sections I and II.A of these comments, numerous industries would potentially be impacted if the products derived from satellite data received at these twenty-seven sites are degraded or no longer available.

Although laudable and extensive effort was undertaken by WG-1 and NTIA to develop the Protection Zones, Raytheon submits that examination of the input data given to NTIA would be prudent. It would also be warranted for the Commission or NTIA to first check sites with known similar sized antennas or near identical systems for consistent input data to ensure the best available values were utilized and establish sufficient confidence in the Protection Zone

²⁴ See *NPRM* ¶¶ 58-59.

calculations. Unfortunately, in a few cases, detailed data on receiving systems located at some of the proposed 27 Federal locations has not proved readily available. Sufficient validation may require further due diligence and consultation with the antenna, filter and receiver vendors once such remaining items are better understood. It should be noted that not all manufacturers of earth station receiving systems publish measured data for all the values which NTIA used as input to the computations. Smaller equipment providers may not necessarily provide the same level of characterization as is found with a much larger diameter command and data acquisition antenna / receiver. In many cases, consultation with the equipment vendor or receiver supplier regarding the particular model at a Federal site is required, with no guarantee that all parameters needed for a particular value have been measured or characterized by that vendor or supplier. Raytheon submits that one final review of the input data used to create the Protection Zones is warranted in a meeting between relevant agencies and regulator technical personnel.

Other administrations with interests in the continued availability of the 1695-1710 MHz band for meteorological satellite downlink purposes in the United States have voiced some disagreement with the Protection Zone criteria recommended in the *NPRM*. For example, EUMETSAT computed the required protection zone for Miami, as this is a receiving site for MetOp data. EUMETSAT's contribution 190 to the ITU JTG 4-5-6-7, cited above, indicates that zones of *hundreds of kilometers* are needed about Miami due to the differing propagation conditions across the water.²⁵ See Figure 1. The Chinese administration indicated that its study

²⁵ The EUMETSAT Advanced Retransmission Service utilizes the NOAA Miami earth station at AOML where EUMETSAT computes the required separation distance of 395 km, but indicates "the required separation distance extends even over the maximum distance ... (395 km) due to the location of the station close to the sea, where propagation is much more favourable than over land." Contribution 190 JTG 4-5-6-7 "Compatibility

results show a large isolation distance (150 km with 5° elevation angle of the earth station) is still necessary, which indicates sharing by AWS stations in the L-band is extremely difficult if not impossible in the vicinity of a downlink earth station in practice.²⁶ Further detailed analysis by the China administration is expected by the next JTG 4-5-6-7 meeting in October 2013. By referencing these administrations' statements, Raytheon is not disputing the computational approach proposed by NTIA for Protection Zones, but simply pointing out several other administrations' concerns regarding Protection Zone sizes.²⁷ The relevance of their views is that the collection of data to further forecasting and other weather-related objectives is an international effort, as explained earlier.

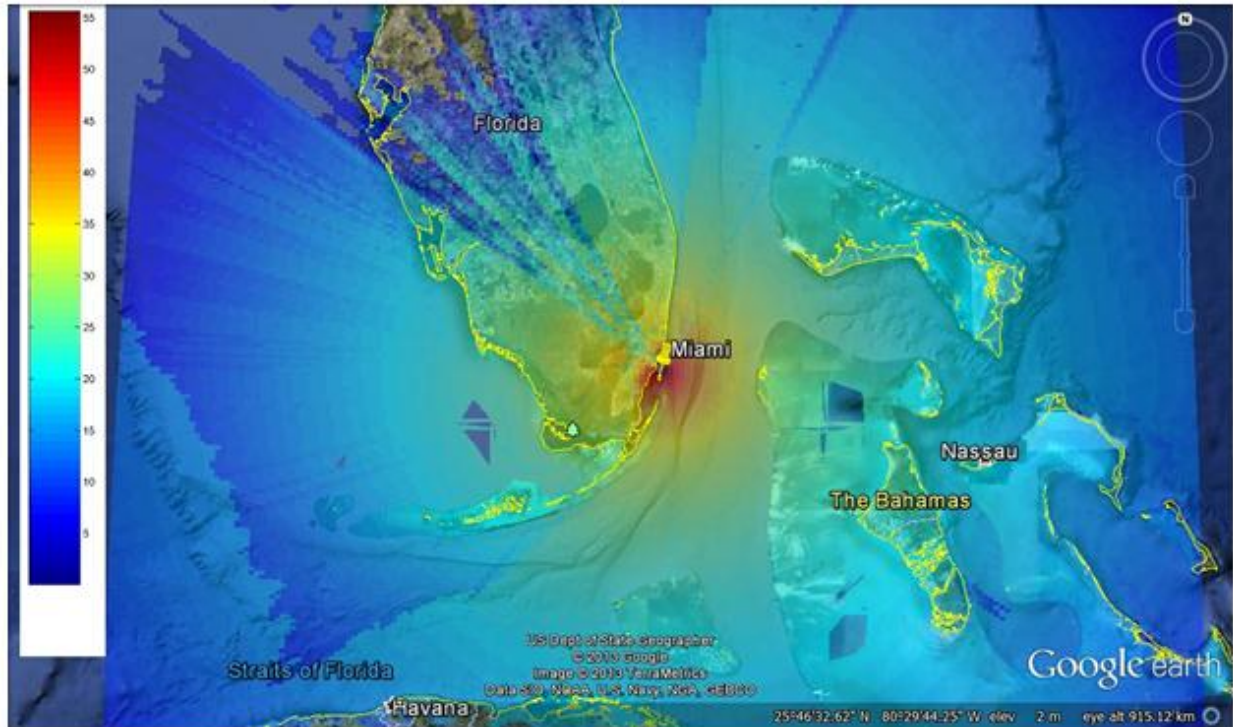
Assessment Between Meteorological Satellite Systems and IMT Stations in the 1695-1710 MHz Band”

²⁶ See <http://www.itu.int/md/R12-JTG4567-C-0199/en>.

²⁷ Given that the Commission's proposed rules recognize the entitlement of operation at the Federal sites to harmful interference-free operation, there is always the backstop that AWS operations both within (if coordinated) and outside the limits of Protection Zones may have to be modified if the Protection Zones and any interference analysis proves inadequate based on real world experience. Ideally, the Commission's rules would be established in such manner as to minimize, if not eliminate, the potential for such interference from outside the Protection Zones.

Exclusion zones around Miami for base station

(The colour indicates the level by which the protection criterion is exceeded)



The *NPRM* fails to consider changes which may be necessary affecting the set of these proposed protected Federal sites in the future. Simply presuming that there will be no such changes – or mandating that this be the case – is unrealistic. New generations of satellite systems – such as the Free Flyer system discussed above – may spawn additional Federal uses for data products which may require modified (or even new) downlink sites operating in the 1695-1710 MHz band. Many aerospace companies such as Raytheon propose and develop solutions for future Federal agency requirements, and permanently limiting data reception to a small set of sites may equally limit contractors' ability to meet federal government requirements in the future. A Federal agency may outgrow a given site downlinking in the 1695-1710 MHz band. Alternatively, a protected site may become unsuitable for continued satellite data

reception over time due to intervening nearby construction blocking visibility to the satellite. Where protected Federal facilities are leased instead of owned, the lease term may end and not be renewed. Should that occur, the need served by the earth station(s) at that site will not end with termination of the lease. Consequently, affected Federal operations may have to be moved to a new location to avoid loss of capability. The development of rules to address these and other potential scenarios is required, including the potential for establishing new Protection Zones and retiring existing Zones.

In addition, Raytheon is concerned that the *NPRM* declines to propose a requirement that AWS licensees in the 1695-1710 MHz band utilize LTE (*e.g.*, 4G) or any other specific standard or standards.²⁸ Failure to mandate an LTE standard could impact directly the validity, already qualified, of the analysis determining the proposed contours of the Protection Zones. The absence of such a proposal in the *NPRM* is somewhat surprising given that the proposed regulatory framework would use the Protection Zones established by the NTIA analysis results reflected in the *WG-1 Report*. All CSMAC working group studies, including those of WG-1, assumed LTE mobiles sharing with the federal facilities would be the interference source.²⁹ Of particular note, LTE may have the inherent flexibility to allow more interoperability with a Federal spectrum monitoring system or to provide near real-time utilization data for mobiles in a given AWS base station sector or area. Such flexibility or other necessary features may be

²⁸ See *NPRM*, ¶ 99.

²⁹ NTIA and the Commission solicited data during the CSMAC WG-1 activity on the equipment at the various 27 Federal sites that made the list for use in deriving the Protection Zone sizes. It should be noted that when comparing large command and data acquisition antennas (over 40 feet in diameter) to smaller receive antennas (approximately 5 or 6 feet in diameter), with differences in test requirements and acquisition cost between the antenna systems, that some performance data on the smaller systems may not have been available.

lacking in other industry standards, which would make such interoperability in support of coordination more difficult if not impossible. By not requiring that AWS licenses use the LTE standard, therefore, the Commission risks undermining the basis for the size of the Protection Zones in the *WG-1 Report*. Without further study by interested parties and potentially affected Federal stations, the use of a wholly different industry standard offers no guarantee that interference protection and sharing objectives will be achieved using the limitations that presumed use of the LTE standard.

As such, if the Commission chooses to forego mandating use of the LTE standard by auction winners, the Commission should act establish *larger* Protection Zones to create an umbrella allowing for the use of other standards. Systems using different operating standards may present different operating characteristics than LTE systems, systems which may pose a greater potential for interference over a larger area of mobile operation to protected Federal sites. Adopting large Protection Zones will not, in the end, preclude any AWS operations within the Protection Zones which can be successfully coordinated. Thus, for LTE systems, there will be no net impact from such a conservative approach.

Raytheon recognizes that the Commission does propose to limit the EIRP of AWS mobiles operating in the 1695-1710 MHz band.³⁰ The Commission also proposes to require that AWS mobiles in the 1695-1710 MHz band operate only when under the control of a base station and with minimum necessary power for successful communications.³¹ Raytheon supports adoption of these measures as among the minimum requirements for any commercial mobile

³⁰ *NPRM* ¶ 103 and p. 85 (proposed rule § 27.50(d)(4)).

³¹ *NPRM* ¶¶ 48 and 103, and p. 85 (proposed rule § 27.50(d)(4)).

system sharing with federal facilities in the 1695-1710 MHz band.³² However, these requirements, while helpful, are insufficient to validate continuing to using the Protection Zones sized as in the *WG-1 Report* where AWS systems do not implement an LTE standard.³³

One final point is warranted regarding the question whether to adopt a specific industry standard: Numerous studies have called for spectrum efficiency as one solution to maximize utilization of the finite electromagnetic spectrum. Raytheon is concerned that older industry standards will not advance greater spectrum efficiency and guarantee interference-free operation for protected MetSat operations in co-channels and adjacent channels and bands. By not recommending an industry standard such as LTE which incorporates dynamic features and functionalities that hold the promise to improve the potential for successful sharing, the Commission would be needlessly risking less efficient utilization of the spectrum being auctioned.

2. Coordination procedures

The *NPRM* seeks comment on “whether any existing coordination models – or elements of those coordination models – may be applicable to the 1695-1710 MHz band.” The *NPRM* also requests comment “other approaches that address the unique circumstances surrounding Federal/non-Federal sharing in this band.”³⁴ The *NPRM* does not make a specific proposal for coordination procedures within the Protection Zones, although it does allude to the guidance that

³² Raytheon urges the Commission to articulate more clearly what is meant by “minimum power necessary for successful communications.” Enforcement of this requirement may become central to ensuring that MetSat systems within Protection Zones are adequately protected.

³³ The Commission acknowledges that sufficient controls are necessary if no standard, LTE or otherwise, is mandatory, and that otherwise a Protection Zone may be too small. *See NPRM* ¶ 99.

³⁴ *NPRM* ¶ 65.

was offered in 2006 to AWS licensees that wished to begin implementing service in the 1710-1755 MHz during the transition of federal operations from the band.³⁵

Given the unique and vital mission of the protected federal sites, the Commission's coordination procedure should not establish any defaults applicable to federal users' responses to Protection Zone coordination requests. In other words, after contacting the federal incumbent operator and providing an interference analysis, the AWS licensee seeking to conduct operations within a Protection Zone should be required to obtain the affirmative consent of the incumbent operator before commencing operation. As a result of the WG-1 process and accompanying NTIA analysis, the original suggestion in the FTR of large Exclusion Zones around the protected Federal sites has been significantly modified. From Exclusion Zones spelled out in the Fast Track Report, areas defined by a 72-121 km radius around the coordinates of a protected site in which AWS operation would not be permitted,³⁶ the proposed regulatory framework has evolved to much smaller Protection Zones within which the AWS licensee will have the opportunity to operate following successful coordination. The contracted Protection Zones around the 27 federal sites to receive protection, following further analysis by NTIA collaborating with WG-1 based on a generic theoretical LTE model, generally are proposed to be less than 60 km radius in

³⁵ *NPRM* ¶ 67. See *The Federal Communications Commission and the National Telecommunications and Information Administration—Coordination Procedures in the 1710-1755 MHz Band*, Public Notice, 21 FCC Rcd 4730 (2006) (“AWS-1 Coordination Procedures PN”). Note that the procedures in the AWS-1 Coordination Procedures PN have never been incorporated into the rules. Rather, the AWS-1 Coordination Procedures PN provides assurance to ASW licensees what the Commission will consider “constitute[s] reasonable effort on the part of AWS licensees to comply with the license condition that they coordinate frequency usage with incumbent federal users.” *Id.* at 4.

³⁶ See Fast Track Report, Nov. 15, 2010, at 4-79, table 4-68. Half of the 18 proposed protected federal sites on the initial list were tentatively afforded Exclusion Zones of 72-97 km, and the remaining half were tentatively afforded zones of 110 km or more.

size, with only four exceptions. More than half of the proposed Protection Zones will have radii less than 40 km.³⁷ In short, the move to the smaller Protection Zones from the earlier conservative Exclusion Zones already reflects a considerable concession to future AWS operations.

Because the resulting Protection Zones are of a sufficiently small size, efforts to operate within those Zones will require more detailed analyses and use of potentially novel techniques by the AWS licensees.³⁸ Further, as part of the coordination process, federal agencies should be presented with, and have the opportunity to evaluate, the principal features of any live monitoring system to be utilized by the AWS licensee to ensure that interference protection criteria to which the AWS licensee must adhere are not exceeded. Accordingly, incumbent federal operators must have a full opportunity to carefully review any data and analyses offered in support of Protection Zone coordination in light of practical realities, which do not justify a short default period.³⁹ Moreover, it is questionable whether all of the affected Federal agencies, which would be some subset of the 19 members of the Interdepartmental Radio Advisory Committee membership, currently have resources to properly conduct coordination with multiple auction winners across multiple license areas simultaneously. Without some additional resources in agencies which may have limited availability of technical resources to conduct and analyze such

³⁷ See *NPRM* ¶ 170.

³⁸ There is no basis to presume that novel sharing methods will not be proposed, particularly if the AWS licensees seek to “push the envelope” and strive to maximize, as best they can, the coordinated area of operation within the Protection Zones.

³⁹ It is also noteworthy that MetSat operators have not had to share or coordinate in the past with other high-density terrestrial users, such that they do not bring experience with this type of task to the process of sharing with AWS licensees. It is to be expected that they may require additional time to review analyses purportedly supporting coordination.

coordination processes, a rule providing for an automatic coordination approval after a set review period would be inappropriate.

In addition, the 1695-1710 MHz band will be used by AWS uplink mobiles and likely will be controlled in a dynamic fashion by base stations using LTE protocols in order to permit coordinated operation. Thus, the interference analyses are likely to involve sophisticated approaches that require close scrutiny. By contrast, in the AWS-1 Coordination Procedures PN addressed coordination within a significantly different technical scenario, channelized terrestrial systems coordinating with other terrestrial systems. Moreover, the MetSat satellite downlinks at issue are susceptible to interference and loss of data, even if not loss of link, from interfering signals as much as 20 dB below the desired signal level (*e.g.*, $I/N = -10\text{dB}$). As such, the interference analysis in the 1710-1755 MHz band was far simpler than coordination in the 1695-1710 MHz band Protection Zones is likely to be.

For the foregoing reasons, any sharing frameworks the Commission has adopted or articulated in other contexts, such as the guidance for coordinating early access to the 1710-1755 AWS-1 downlink band, which include provisions that allow AWS licensees to assume federal agencies have no objections to the proposed operation if a certain time passes should *not* serve as a model. Rather, AWS licensees should have to obtain *affirmative agreement* from protected incumbent operators in the same or adjacent bands before commencing operation in the 1695-1710 MHz band. This is a proper balance of competing factors in light of the move from large Exclusion Zones to much smaller, on average, Protection Zones.

Raytheon is mindful of the fact that some of the Protection Zones overlap with or are near large urban centers, where demand for wireless system capacity is often greater than in the country as a whole. Auction winners whose licenses overlap with such Protection Zones will no

doubt desire to have the coordination process proceed expeditiously. Accordingly, it would be appropriate for the Commission rules to direct AWS licensees to contact NTIA for assistance after sixty (60) days if they have not received consent to a coordination request. But Raytheon does not suggest any time specific limit on responses from a Federal agency, nor believes any limit should be imposed by this process. By contrast, there is no justification for presuming that an incumbent federal MetSat user has no objection to a coordination analysis by an AWS licensee seeking to operate in all or part of a Protection Zone simply because it has not responded within a set period of time.

Where coordination requests are rejected by the federal incumbent, there should be no automatic opportunity for appeal. Federal agents can be expected to raise legitimate objections to a proposed coordination, and share these with an AWS licensee that has proposed operation within a Protection Zone. However, where coordination is not successful, Raytheon would expect that Federal incumbents will work in good faith with AWS licensees that present alternative options for operating within an area falling within a Protection Zones. Moreover, Raytheon anticipates that the Commission and NTIA will both make themselves available to assist parties in reaching a successful coordination should bilateral discussions get bogged down.

The rules should also make clear when AWS licensees that have already coordinated successfully with a Federal user wishes to make changes to their operations, *they may have to engage in further coordination*. Any coordination analysis should describe the area in which mobiles will potentially operate within a Protection Zone. If proposed AWS system modifications would increase the area of operation within a Protection Zone beyond that previously coordinated, then a new *advance* coordination with the federal incumbent should be required. Any other changes that would increase the interference potential of the AWS system

should also require re-coordination, for example, changes that would allow the AWS system to handle more mobiles operating within the Protection Zone than had been assumed in the interference analysis supporting the earlier coordination, even if the geographic area of operation does not change. The rules should make clear that the circumstances in which further coordination is not required if there are changes to the AWS network expanding operations or system capacity in or the near vicinity of a Protection Zone are limited.

3. Interference Prediction Model

For each incumbent receiver in the 27 proposed Protection Zones, the *WG-1 Report* recommended establishing interference protection criteria that define the allowed Interference Power Spectral Density (“IPSD”) levels resulting from AWS operation tailored to each receiver’s radiofrequency characteristics.⁴⁰ The *NPRM* recognizes that not all such work has yet been completed to support the coordination process. In particular, the *NPRM* recognizes that there is still a need for a nationally-approved interference prediction model, as the *WG-1 Report* explained.⁴¹ Raytheon will review with interest the initial comments of proponents of the AWS allocation in the 1695-1710 MHz band for discussion regarding the interference prediction model with an eye toward possible comment in the reply round.

Of particular importance in the area of interference prediction, the *NPRM* echoes *WG-1 Report*’s concerns that not enough is known about the effect of multiple operators operating in

⁴⁰ The *NPRM* raises the question of whether modifications of the methodology are needed to provide a more realistic assessment of the potential interference calculation in paragraph 64. Raytheon submits that the Commission may wish to consider the procedures in ITU-R P.452 “Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz” as another technique applicable to this proceeding.

⁴¹ See *NPRM* ¶ 55.

the vicinity of an incumbent federal earth station.⁴² The NTIA analysis of interference protection levels assumed a single operator whose mobiles were all centrally controlled from a single source. The Commission's rules should seek to be guided by that model in situations where there may be more than one operator within or in the near vicinity of a single Protection Zone. More specifically, Raytheon submits that AWS licensees must be required to adhere to and monitor adherence to Protection Zone-specific interference protection criteria ("IPC") and adjust their system operations immediately should the IPC be exceeded, whether harmful interference is reported by the Federal user or not. The IPC limits should be allocated equally among those operators with licenses that overlap or abut the Protection Zone.⁴³ The Commission should leave it to the operators themselves to negotiate whether and how they will depart from their equal share, with the condition that any arrangement must ensure that, *in combination, the IPC limit is not exceeded by their operations*. Provided that condition is satisfied, the multiple AWS licensees should be free to reach any arrangement mutually acceptable to them, whether that arrangement is dynamic or static. For administrative ease, all of the licensees in a given area overlapping all or part of a particular Protection Zone should be held equally responsible to implement a solution to the extent the IPC limit is exceeded by them in combination. Further, if there is an investigation related to, or forfeiture for, harmful interference to a protected incumbent operation within the Protection Zone, each of the AWS licenses should be jointly and severally liable for cooperating with the investigation and for the entire amount of any forfeiture.

⁴² NPRM ¶¶ 60-62; *see also WG-1 Report* at Appendix 1, at 1-1, Paragraph 1.b.1..

⁴³ One practical issue that may arise where a single Protection Zone overlaps the licensed area of operations of two or more AWS providers is whether the first AWS licensees to seek coordination should have any priority over the other the other licensees that seek to coordinate later. Assigning each licensee a default share of the IPC limits, unless the licensees agree among themselves to different shares, resolves that issue.

Between themselves, they may agree to allocate that responsibility, but the allocation is a matter strictly between them and need not be codified into the rules or involve the protected Federal operations.

4. Pre-Operation Test Program

As the *NPRM* recognizes, “[t]he *WG1 Final Report* also recommended establishment of a testing program that would “demonstrate the viability and effectiveness of proposed protection and mitigation methods before commercial licensees may begin operations within a Protection Zone.”⁴⁴ As a threshold matter, such testing should be designed to validate the analytic model and results that were the basis for establishing the size of the Protection Zones. The testing will require not only the participation of the protected Federal systems but also terrestrial mobile equipment representative of the licensee’s intended operations in the 1695-1710 MHz band, with representative loading.

Unless a known industry standard is mandated, testing prior to the adoption of Commission rules would appear impractical, and even premature. Consequently, the recognized need for pre-operation testing and validation of the Protection Zones cannot be satisfied unless the Commission mandates the use of the LTE standard by the AWS auction winners. Moreover, the Commission’s rules should make clear that, if such testing and validation does not occur until after the auctions based on the operating standards of the auction winners, the Protection Zones in individual cases may have to be resized as a result of such testing. Because the Protection Zone contours may prove too small as a result of testing, it is not enough to require that validation testing simply occur prior to any submitted requests for coordination. Raytheon submits that the testing must occur before operation outside the Protection Zone commences.

⁴⁴ *NPRM* ¶70, citing *WG-1 Report* at 2.

5. On-Going Real-Time Monitoring

Even though a coordination proposal is “approved”, the potential for interference remains. Indeed, the potential for interference from operation outside the Protection Zones is also real. Thus, the *NPRM* explains that “[t]he WG1 Final Report notes that real-time monitoring of IPSD limits with automated adjustments would be ideal in order to ensure that the established interference limits are not being exceeded.”⁴⁵ Raytheon agrees that the Commission should mandate real-time monitoring requirements of adherence to interference protection criteria (“IPC”) on all AWS licensees in areas overlapping, or in close proximity to, Protection Zones. Such monitoring obligations imposed on AWS licensees should be independent of and complement any monitoring by Federal users at protected sites of the undesired signals received that may cause harmful interference. Both are critical to ensuring interference-free operation of the protected Federal MetSat facilities.

Raytheon submits, therefore, that the rules should establish two distinct interference criteria. First, an AWS licensee should be required to adhere to an IPC which will be Protection Zone-specific. The AWS licensee should be required to monitor its system’s compliance with the applicable IPC, and the rules should provide that, as part of any Protection Zone coordination request, an AWS licensee must explain how IPC adherence will be monitored. Any failure to monitor the IPC or operation in excess of the IPC should subject the AWS licensee to enforcement action.

Second, the value of $I/N = -10$ dB at a protected Federal earth station should be adopted as a level that represents undesired interference per se. This level has been called the maximum allowed interference power spectral density (“IPSD”). Raytheon anticipates that the IPSD will

⁴⁵ *NPRM* ¶¶ 55, 71; *see also WG-1 Report* at 2.

be monitored by the Federal user, with the assistance of the AWS licensees with which it has coordinated or which operate in the near vicinity of the Federal user's Protection Zone.

Generally speaking, AWS licensees would have several options to establish monitoring systems, working cooperatively with the Federal incumbent licenses and designated Federal spectrum experts, such as deploying a sufficient number of monitoring stations in close proximity to the Federal Earth station, with locations mutually determined depending upon the network configuration of the AWS licensee's system. It is conceivable that the "monitoring stations" established by the AWS licensee are inherent and integral parts of its wireless network, which allow it to maintain knowledge of the changing usage within all base station sectors in the proximity of, or within, the Protection Zones. The AWS monitoring systems would ensure that IPC value allotted by the Commission to one (or more) AWS licensees in the vicinity of a particular Protection Zone is not exceeded. These AWS monitoring systems should also be able to provide historical measurement data for interference source identification.

Where there are multiple licensees that seek to operate within the Protection Zone (following coordination) or in its close proximity, they should be free to jointly operate or benefit from a single AWS-based monitoring system, if feasible, choosing to share the costs of operation and maintenance of such a system according to private agreement. The shared burdens for the AWS monitoring system are best left to the AWS licensees to determine themselves.

However, as a regulatory matter, each licensee that has coordinated or is operating in close physical proximity to a Protection Zone contour should have individual responsibility to conduct adequate ongoing monitoring, remain below a required IPC limit and to provide relevant information to the Federal user, even if some of these requirements can be satisfied through a

joint arrangement with the other “nearby” licensees.⁴⁶ Moreover, it should be the responsibility of the AWS licensees individually and as a group to work out the monitoring of their respective individual IPC allocations.

Despite AWS licensees’ real-time monitoring of IPC levels, which should be mandatory, Raytheon submits that Federal MetSat operations within the proposed Protection Zones, as a practical matter, will be likely to conclude there is a need for their own spectrum monitoring systems at the protected Federal sites. A Federal operation is in the best position to determine the composite effect of interference on the intended satellite downlink signal from AWS operations and, therefore, is the place where compliance of an $I/N = -10$ dB or other measure of harmful interference should be validated. Federal sites would be trying to detect signals that fall 10 dB below their Earth station receiving system noise floor, requiring measurement and potentially computational techniques to recover such signals in the presence of the desired satellite downlink signal. Changing propagation conditions, changes in loading of one or more AWS licensees, and possibly even outside interference sources (non-AWS) all have the potential to combine to violate the IPSD limit. A Federal monitoring receiver would need adequate antenna gain to emulate the actual Earth station antenna parameters. A Federal user’s monitoring efforts would benefit from cooperation by all the nearby AWS licensees in or adjacent to the spectrum of interest. The AWS licensee(s) likely can quickly assist in identifying the source of the undesirable interference should it arise. Without full cooperation of and interaction with the AWS licensees, identification of an actual source of interference could be a challenging technical problem for the Federal user. Considering that AWS system usage will

⁴⁶ AWS licensees should provide real-time or near-real reports to the Federal user on those levels as necessary for the Federal user to support its own monitoring and interference mitigation efforts.

regularly change on the order of milliseconds, in many situations identifying the AWS licensee system that is the interference source will not be a simple problem.

Raytheon submits that more work is needed on interoperability of dedicated AWS spectrum monitoring systems with terrestrial base stations and the integration of Federal monitoring components into the affected Federal receiving systems. The Commission's rules should take into account that the antenna gains and the patterns of satellite antennas are vastly different than the typical spectrum monitoring antennas typically utilized by the terrestrial systems. The gain of an earth station antenna and the sensitivity and pass band of the associated receiving system typically has the capability to detect more signals than a terrestrial receiver in a commercial configuration. This is why a properly designed Federal monitoring system may detect more signals than a corresponding AWS monitoring installation which does not have the gain and antenna pattern of a satellite earth station antenna.

The rules governing interference criteria and AWS licensee's obligations to conduct IPC adherence monitoring or support Federal IPSD monitoring must reflect both the need to meet a Commission-imposed IPC allotment and for direct interaction and cooperation with a Federal licensee who is encountering interference or undesired degradation in signal reception. Thus, the rules should provide, first, an IPC allotment for which the AWS carrier must monitor their own compliance and, second, that the AWS carriers in defined circumstances must exchange AWS network and monitoring system data with the Federal licensees. The ultimate measure of actual undesired interference is the composite IPSD as received by a Federal monitoring station. Further, for unclassified Federal systems, such as civil environmental systems, the direct presence of all AWS licensee representatives at the appropriate Federal control facility may be

the most effective way to quickly resolve actual interference issues, potentially in support of multiple sites within that Federal agency.

The *NPRM* notes that, ideally, if the monitoring system detects that IPC limits are being exceeded, the AWS operations should be adjusted immediately, *i.e.*, automatically using network controls integrated into the AWS system, to bring the IPC back to or below established levels.⁴⁷ Raytheon supports adoption of such a requirement in principle. Additional work is needed to ascertain if this can be done automatically. If actual undesired interference occurs which violates the $I/N = -10$ dB level at the Federal earth station, the *NPRM* observes that monitoring may not necessarily determine the source of the problem. Certainly, if the source of the problem is other than AWS operations, the AWS licensee(s) should be encouraged to ascertain that fact, if possible, and bring it to the attention of the Commission and the Federal licensee.

6. Resolution of Interference Incidents

The *NPRM*, and in particular the proposed rules, recognize that the incumbent federal systems within the 27 proposed Protection Zones should be entitled to interference free operation from both coordinated operations inside the Protection Zone and uncoordinated operations.⁴⁸ Accordingly, rules regarding interference resolution should create incentives for AWS licensees to resolve any interference incidents promptly. In the case of coordinated operations within a Protection Zone, the proposed rules would provide not only that there be advance coordination by AWS licensees with protected federal sites, but that if a federal user receives harmful interference and notifies the coordinated AWS licensee, the AWS licensee must “modify the

⁴⁷ See *NPRM* ¶ 71.

⁴⁸ See *NPRM* at 88, and proposed rules §§ 27.1134(c)(1)(i) and 27.1134(c)(2).

stations' location and/or technical parameters as necessary to eliminate the interference.”⁴⁹

Raytheon agrees with this in principle.⁵⁰ However, the rule should more clearly indicate that the AWS licensee’s response must be “immediate,” and a “stop buzzer” contact should be made available as discussed below.

Further, if interference is received by a protected federal site but no AWS licensee’s system has been coordinated to operate within the Protection Zone, the incumbent Federal operator should enjoy the same level of protection against interference caused by the AWS operations. Specifically, the rules should provide that the incumbent operator can notify those incumbent operators whose authorized territories include or are adjacent to the Protection Zone. In such event, the AWS licensees should have the same obligation to modify their systems’ operation immediately to eliminate the interference. If the AWS licensee(s) believes that the interference is coming from a different source, the licensee, after taking any reasonable action to mitigate the interference to which it may be contributing, should be required to investigate that source with the cooperation of the federal licensee, if necessary.

Identification of interference sources will in some cases require close technical cooperation between the Federal agencies and the AWS licensee(s). Raytheon notes, although is not within the purview of the Commission, agencies will require resources to conduct these

⁴⁹ *NPRM* at 88, and proposed rule § 27.1134(c)(1)(i).

⁵⁰ Since the interfering station would, under the proposed operational rules, be a mobile or portable unit, it is likely that the interfering station’s location will no longer be as it was during the interference. Moreover, because the systems operating in 1695-1710 MHz must be under control of a base station before they can transmit and use the minimum amount of power for effective communications, the interference is more likely to be the consequence of an AWS system or network problem, rather than the fault of an individual mobile station. Therefore a more appropriate example of an AWS licensee response to notification would be a change in system parameters and controls to eliminate the potential for interference by its *wireless network*.

efforts. Agencies should also be guaranteed a funding source for the monitoring and coordination efforts, after any Spectrum Relocation Fund monies are consumed, because this joint monitoring effort will be required for as long as AWS licensees operates in proximity to the protected Federal stations.

The Commission should consider that the failure to adopt a particular AWS technical standard for operation in the 1695-1710 MHz band, such as LTE, will potentially render more difficult and complex efforts by Federal users to resolve interference events, making the AWS licensees' role all the more critical. Further, while the Commission proposes that AWS licensees maintain a point of contact "at all times,"⁵¹ the *NPRM* stops short of imposing a stop buzzer requirement. However, Raytheon submits that such a stop buzzer requirement, at least for AWS operations that have been coordinated within Protection Zones, is vital to ensure that interference ceases promptly. Without a clear stop buzzer requirement, or the equivalent, interference that occurs because of a systemic flaw in an AWS provider's operations could linger while the parties deliberate over confirmation, allocation of responsibility to end the interference, and a permanent solution. Moreover, without a stop buzzer requirement where there are multiple licensees coordinated to operate within a Protection Zone, the interference may continue unabated if all of the AWS licensees do not have equal obligations to assist in eliminating the interference to the protected site. The stop buzzer requirement is properly viewed as part of the price for operation within the Protection Zones.

To ascertain what permanent solution is appropriate, such as an adjustment to previously coordinated operations, where an AWS licensee does not make such adjustment unilaterally, coordinated AWS systems should be required, upon reasonable request, to share with the Federal

⁵¹ *NPRM*, p. 88, and proposed rule § 27.1134(c)(1)(i).

user in real-time or near real-time the number of mobile users per base station sector with the Protection Zone. Were data provided on the utilization of mobiles in base stations within and adjacent to Protection Zones, this would aid in the identification of interference sources which otherwise may be difficult for a Federal user to accomplish without direct real-time information and interaction with the AWS systems.

7. Commission Enforcement

As increased sharing occurs between new users and incumbent users in an effort to maximize use of the spectrum and satisfy the demand of commercial mobile broadband providers to meet the capacity needs of their customers, as is proposed in the 1695-1710 MHz band, it is important that the Commission have a robust enforcement policy and practice in place. Unfortunately, in some other recent sharing scenarios, the existence of seemingly clear technical and operational regulations has not prevented operations outside the bounds of the rules, including by well-established industry participants. A notable example is the operation of U-NII devices in the 5 GHz band on a shared basis with Terminal Doppler Weather Radars ("TDWRs"). There, in a number of cases, operators have utilized equipment that did not conform to the Commission's rules or have deactivated controls on the devices designed to ensure sharing without causing harmful interference to the TDWRs.⁵² Appropriately, the Commission moved to enforce the rules against offenders to minimize future occurrences of interference.

⁵² See, e.g., the following notices of apparent liability of forfeiture and orders: *VPNet, Inc.*, 27 FCC Rcd 2879 (Enf. Bur. 2012); *Argos Net, Inc.*, 27 FCC Rcd 2786 (Enf. Bur. 2012); *Insight Consulting Group of Kansas City, LLC*, 26 FCC Rcd 10699 (Enf. Bur. 2011); *Ayustar Corp.*, 26 FCC Rcd 10693 (Enf. Bur. 2011); *Rapidwave, LLC*, 26 FCC Rcd 10678 (Enf. Bur. 2011); *AT&T, Inc.*, 26 FCC Rcd 1894 (Enf. Bur. 2011); *Utah Broadband*, 26 FCC Rcd 1419 (Enf. Bur. 2011) (forfeiture paid).

The Commission should, once it has adopted the rules to govern sharing, act to enforce the rules vigorously and uniformly. Because IPC levels should be monitored by licensees in real-time, as discussed above, in any cases of interference, the Commission will have available to it a record of network operational evidence at the time interference occurred which can be used to aid enforcement. Thus, records of AWS-monitored IPC levels at both co-channel and adjacent channel protected sites should be maintained by the AWS licensees for a sufficient period of time and be made available to the Commission upon request.

The Commission should make itself available not only to aid in interference resolution, as parties may request, but it should also should act swiftly and firmly in enforcement proceedings to avoid allowing AWS licensees to develop a sense that it may be worth their while to violate the sharing rules by, to name a few examples, exceeding IPC limits, failing to deploy and maintain monitoring systems, operating in Protection Zones without coordination, or expanding operations beyond what has been previously coordinated. Enforcement fines and forfeitures should be at suitable levels and promptly determined to deter future violations. Compliance plans in the case of violations should be stringent and meaningful. The Commission should also make clear that in particularly egregious situations of interference or failure to comply with technical or operational standards, loss of license may be a remedy.

8. Interplay between Protection Zones and Performance Requirements

The *NPRM* proposes performance, or buildout, requirements for future AWS licensees in the 1695-1710 MHz and other AWS-3 bands and inquires, among other things, how the Commission should “account for the areas where Federal use limits or prohibits AWS-3 use.”⁵³ In brief, the Commission proposes to require AWS-3 licensees to provide reliable signal

⁵³ See *NPRM* ¶¶ 127-129.

coverage and offer service to 40 and 75 percent of the population in each of its license areas within four and ten years, respectively.⁵⁴ The Commission, rightly, seeks an “appropriate balance between [buildout]requirements that are too low as to not result in meaningful buildout and those that would be so high as to be unattainable.”⁵⁵ As explained below, Raytheon submits that the populations within Protection Zone should not be used to measure whether build out requirements are met.

As the Commission observes, the primary purpose of the buildout requirements is “to promote the efficient deployment of wireless services, including to rural areas, and to ensure that spectrum is used.”⁵⁶ The regulatory framework which the *NPRM* proposes for 1695-1710 MHz, which Raytheon supports as qualified in these comments, is predicated upon the existence of relatively tight Protection Zones in which AWS operation may be successfully coordinated at some time in the future. There is no guarantee to a winning bidder for a license for which the authorized area includes all or part of a Protection Zone that the license will ever be able to operate within the Zone.

When proposed coordinations for AWS operations in the Protection Zones are evaluated, the sole consideration should be whether the proposed operations would pose a threat of harmful interference to the protected federal facilities. There should be no added pressure for a successful coordination as a result of performance requirements.⁵⁷ Further, inclusion of

⁵⁴ *Id.* ¶ 127.

⁵⁵ *Id.* ¶ 129.

⁵⁶ *Id.* ¶ 126.

⁵⁷ Certainly, the Commission cannot determine in advance whether something less than the full the population within a Protection Zone is included or excluded in performance measures. Any other proposition would be unworkable administratively.

Protection Zone populations may prove fundamentally unfair to licensees in cases where future coordination does not prove workable. In other words, including Protection Zone populations may make the buildout requirements unattainable. Finally, efficient use of spectrum will not be compromised by excluding Protection Zone populations because the protected Federal sites are already using the spectrum within the Protection Zones for vital meteorological missions. If coordination within the Zones proves successful, the additional use of the spectrum will be a superefficient result.

9. Pairing Configurations

Although Raytheon has no objection to the general concept of meteorological satellite systems sharing the 1695-1710 MHz with the AWS, provided the issues above are adequately addressed to protect those stations from harmful interference, it disagrees with the commercial industry suggestion of using 2095-2110 MHz as the downlink/base station spectrum paired with the 1695-1710 MHz band.⁵⁸ NASA has prepared a comprehensive analysis on co-frequency interference to the Tracking and Data Relay Satellite System spaceborne receivers which renders any shared use with AWS operations in 2025-2110 MHz infeasible.⁵⁹ Raytheon urges the Commission, as a result, to avoid pairing 1695-1710 MHz with any segment of 2025-2110 MHz. Indeed, to protect existing Federal uses of 2025-2110 MHz, this band should not be made available to non-Federal users.

⁵⁸ See *NPRM* ¶ 20.

⁵⁹ <http://www.itu.int/md/R12-JTG4567-C-0170/en>

10. Potential Relocation of Federal Receive Locations in the 1695-1710 MHz Band

The WG-1 Final Report explains that commercial wireless “industry participants have proposed examining the feasibility of relocating these receive stations to less populated areas. However, to date, the feasibility and associated costs have not been studied.”⁶⁰ The *NPRM* outlines the challenges that a Federal MetSat receiver relocation study would need to address.⁶¹ The criteria for locating and operating a Federal earth station in the context of a larger data processing and dissemination system is much more complex than one might assume from casual examination. Raytheon elaborates briefly below on the six points referenced in the *NPRM*:

a) “a receive site is located in a suitable area to capture necessary data”.⁶² Visibility of an earth station antenna to the polar-orbiting satellite is an essential consideration with regard to site selection. Due to orbital geometry, an earth station tracking satellites in polar-orbit must effectively look in all azimuths during the multi-day cycle of orbits of such a satellite. Visibility in all directions down to a low angle above the horizon is critical to track orbital passes that are not directly overhead. For satellite passes that do not approach directly overhead, the zenith, at the earth station, pass duration in these instances can be much shorter than for “high elevation” passes at a given antenna. Consequently, a much shorter window to downlink data is associated with these passes.

A coastal location would allow relatively unobstructed low elevation passes over the water that might not be possible for an inland station. For example, NOAA’s Atlantic

⁶⁰ WG-1 Report p. 5.

⁶¹ See *NPRM* ¶ 72.

⁶² The quotations in the headings of subsections a) through f) are taken from *NPRM* ¶ 72.

Oceanographic and Meteorological Laboratory in Miami receives data from polar satellites⁶³ in support of multiple uses, including satellite data inputs from polar-satellites into hurricane prediction models from the Atlantic region where tropical storms often form, detection of harmful blooms in the ocean that can taint the edible products of the fishing industry, oil spill tracking, coverage of the Gulf of Mexico and the Caribbean regions, continuous tracking of ocean buoys via ARGO, relay of HRPT data from MetOp for EUMETSAT. The missions of this Miami station require the wide ranging visibility with minimal or no obscura which are satisfied admirably at its current placement. Selection of a site must consider natural obscura and current and potential man-made obscura which would block satellite reception at certain azimuths. Selection must also consider just how earth station antenna control mechanisms function and down to what level of elevation during operations and prior to satellite signal acquisition.

b) “the location is in a rural enough area to minimize the size or need for Protection Zones in high population areas”: Comparisons of urban versus rural locations of earth stations which receive large amounts of time sensitive data is always complex. To minimize signal interference, such an antenna would seem best situated in a rural or less densely populated area. However, to carry the requisite volume of MetSat data, with adequate reliability, generally requires access to large capacity fiber cables, which in turn can connect to the appropriate major network or cloud for delivery to a processing center. Access points for such fiber systems are rarely at a rural location that meets the criteria for availability, has suitable power and physical infrastructure, has adequate physical security and staff to support the antenna, are allowed under the zoning and environmental laws that apply, and meets the obscura criteria discussed in

⁶³ Note that 1 km POES data, *i.e.*, HRPT data, discussed above, are only downlinked in the geographic region of interest and are not stored. Therefore, if the data are not downlinked at the earliest opportunity, the data are, as a rule, permanently lost.

subsection a), above. It can be cost prohibitive to identify such an ideal location, move or construct new antennas at that spot and sustain multiple antenna systems, assuming a candidate location that meets all the criteria is found.

c) “reliable power is available”: Earth station antennas for MetSat systems require multiple sources of commercial power and additional diesel generator and battery backup systems. Often unless the antennas are co-located with one or more other functionalities at the site, installation would also require construction and sustainment of backup power systems. Configuration of commercial and backup power systems are factored into overall system availability which are specified in Federal ground system requirements.

d) “adequate and redundant backhaul facilities can be established to ensure highly reliable reception of data”: Usually backhaul facilities are a major consideration as alluded above in subsection b). Adequately sized fiber access must be available, with redundant routing, back to a data center or network which can then transport the data to a NOAA processing facility. The redundancy is critical to avoid data disruption because one leg of the fiber can be damaged by construction or equipment failure; availability requirements on the total system would dictate how many paths would be required to meet those requirements at a system level. The absence of such redundant capacity could severely limit candidate relocation sites.

e) “Any delay in receiving raw satellite data introduced by a remote receiver is minimal and does not negatively impact the government mission”: If a MetSat earth station is moved to a new location, this will affect when the data are received or if they are simply lost. Potentially data pertinent to a given region could be delayed as a result of a relocation to the next orbital pass (on a regular basis) or at another geographically different station. If the data is not stored, as noted above, it may simply be lost. Naturally, either result may prove detrimental to

achieving the overall mission. Depending on the design of the satellites at issue and the scope of their missions, data reception delays as a result of a potential relocation may effectively become permanent data losses. Such issues would have to be carefully examined in the context of any potential relocation.

f) “Any suitable site is able to meet applicable environmental statutory and regulatory requirements to build out of such a facility”: Earth stations in radomes or large earth station antennas may fall under a different zoning category than smaller antennas or structures. Such structures may be unacceptable for aesthetic or other reasons under local environmental regulations.⁶⁴ Installations must comply with applicable Federal, state and local laws.

III. CONCLUSION

For the foregoing reasons, the Commission should establish AWS rules that that appropriately protect Federal MetSat receive earth station operations at the proposed 27 sites in the 1695-1710 MHz band and the adjacent 1675-1695 MHz band. Of primary significance, the analysis that led to the proposed Protection Zones contours must be tested and validated in each case, with adjustments made to Protection Zone sizes if necessary. Coordination within Protection Zones should require affirmative consent from the incumbent Federal user(s). Furthermore, AWS licensees should be responsible for monitoring their operations to ensure that applicable IPC limits associated with protected Federal sites are not exceeded, coordinating with other AWS licenses when more than one has operations that may impact a protected Federal site. On occasions when the IPC limits are exceeded, AWS licensees should be required to make

⁶⁴ For example, the aesthetic reasons that could degrade or impact a property owner’s viewpoint are critical (limiting) considerations in selecting an earth station location in Hawaii.

immediate adjustments to their system operations to prevent recurrence. In addition, AWS licensees should have the responsibility to cooperate with and support Federal users in cases of harmful interference, whether caused by operations inside or outside a Protection Zone. Finally, Commission enforcement of the AWS rules governing sharing in the 1695-1710 MHz band should be rigorous and promptly administered.

Respectfully submitted,

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